RELATIONSHIP BETWEEN ULTIMATE PH, SHELF LIFE, AND DRIP LOSS OF PORK LOINS

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Background

Ultimate pH (pHu) of pork is an important quality characteristic affecting sensory quality and shelf life. Dependent on genetics and glycogen levels at slaughter, pH varies from 5.3 to 7.1. 'Normal' pork has a pHu in the range of 5.3-5.9 (Offer et al., 1989). Ultimate pH and water holding capacity are related. A higher pH is associated with a higher water holding capacity, translating into lower drip or purge losses during storage, and a higher yield when processing (Eikelenboom et al., 1995). The reason for the reduced shelf life of high pH meat is not clear. Most bacteria that grow on meat, use glucose as their primary source of energy. Spoilage of meat occurs when glucose is exhausted, and bacteria degrade amino acids, proteins and lipids. The breakdown products of these nutrients (ammonia, fatty acids, polypeptides, sulphurous compounds) are odorous, cause discoloration and may result in slime formation. The National Pork Producers Council suggests selection of pork with a pHu greater than 5.7 for good quality. Currently, more than 80% of pork loins in the US are "enhanced" or pumped with a solution containing alkaline phosphates and some salt to increase pH and water holding capacity. It would be extremely useful to determine if the relationship between pHu and shelf life is linear and/or if there is a critical pHu value above which shelf life is significantly shortened.

Objectives

The objective of this study was to evaluate the relationship between ultimate pH and vacuum packaged shelf life as determined by microbiological quality and drip loss.

Methods

Thirty-six loins were selected at a commercial slaughter facility one day post-slaughter based on ultimate pH, vacuum-packaged, and stored at 4 °C. All pigs were from the same genetic line. Table 1 shows the 5-pH groups that were used in this study. Vacuum packaged pork loins were stored for 5 weeks to simulate the target shelf life needed for export to Japan. Pork loins were sliced for retail packaging after vacuum packaging and stored for 5 days at 5°C. Aerobic plate counts (APC) performed at days 6, 14, 24 and 34 after packaging.

Table 1. pH Groups and Number of Samples for Vacuum-Packaged Pork Loins at Day 0

Group	1	2	3	4	5
pH range	5.55-5.70	5.71-5.85	5.86-6.00	6.01-6.15	>6.15
Number of samples	5	11	7	7	6

Drip loss was measured by determining the amount of purge in each package at days 6, 14, 24 and 34. This was done by taking the difference between the initial weight (at the start of incubation) and weight following storage. Percentage drip loss was calculated as follows: % Drip loss = ((Initial Weight - Final Weight)/Initial Weight)*100. Data were analyzed using ANOVA.

Results and discussion

The results of the total APC and drip loss of the vacuum packaged loins at 6, 14, 24, and 34 days after packaging are shown in figure 1 and 2, respectively. Aerobic plate counts were significantly lower overall in pH group 1 and 2 than group 3, 4, and 5.

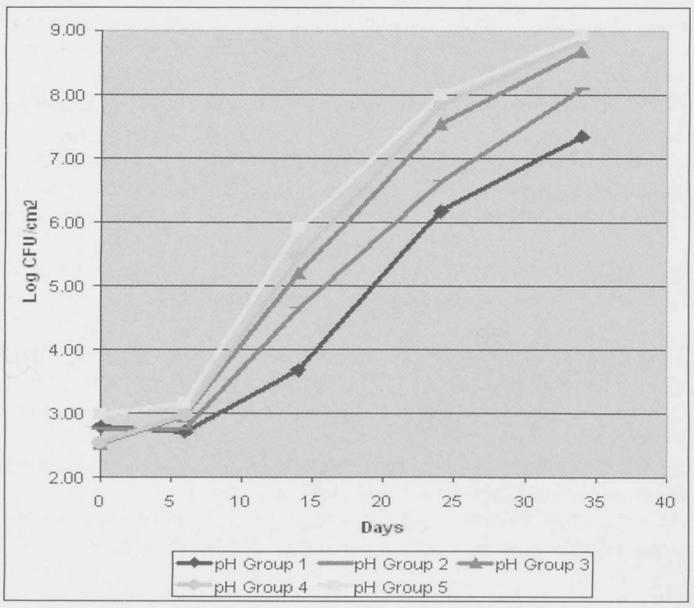

Figure 1. Aerobic plate counts of vacuum-packaged pork loins as affected by pH.

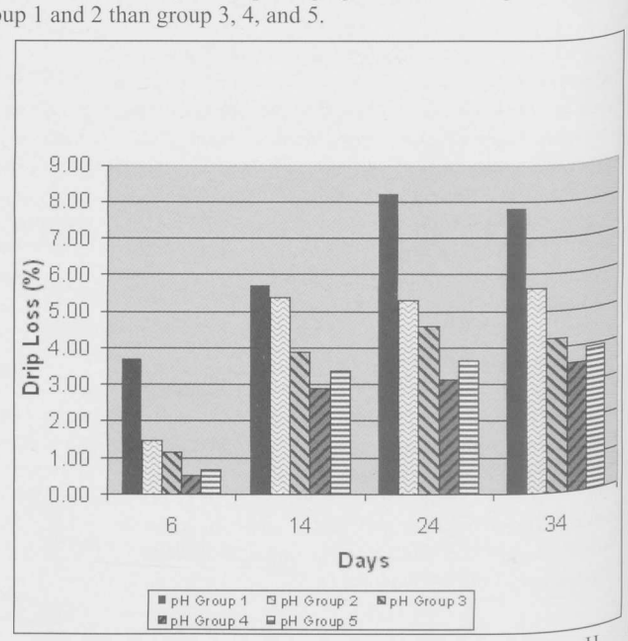

Figure 2. Drip loss of vacuum-packaged pork loins as affected by pH.

Lag phase for all groups was between 6 and 14 days. However, group 1 was consistently 1.5-2.5 logs lower than groups 3-5. Time to reach log 7.0 CFU/cm^2 for group 1 was 12 days longer than for groups 3-5. Log 7.0 CFU/cm^2 is often used as the projected level of spoilage. It should be noticed, however, that the actual APC were higher at different times after storage than under commercial conditions. Samples were

stored at 4°C for this experiment. Vacuum packaged loins will be kept closer to 0°C under long-term commercial storing conditions. These data show that the lower pH pork samples (<5.85) had longer microbiological shelf life than samples with higher pHs.
The drip loss of vacuum-packaged pork loins increased during storage and was highest in pH group 1 (Figure 2). Group 1 (pH 5.55-5.70) demonstrated the greatest drip loss ($p < 0.05$) at 24 and 34 days. The difference between groups 1 and 5 at days 24 and 34 was 4.6 and 3.9%, respectively. At day 6, the percentage drip loss for pH groups 4 and 5 was significantly lower than for group 1. Drip loss was not significantly different between groups after longer storage. These findings were generally expected from the literature (Rey et al., 1976; Offer et al., 1989).

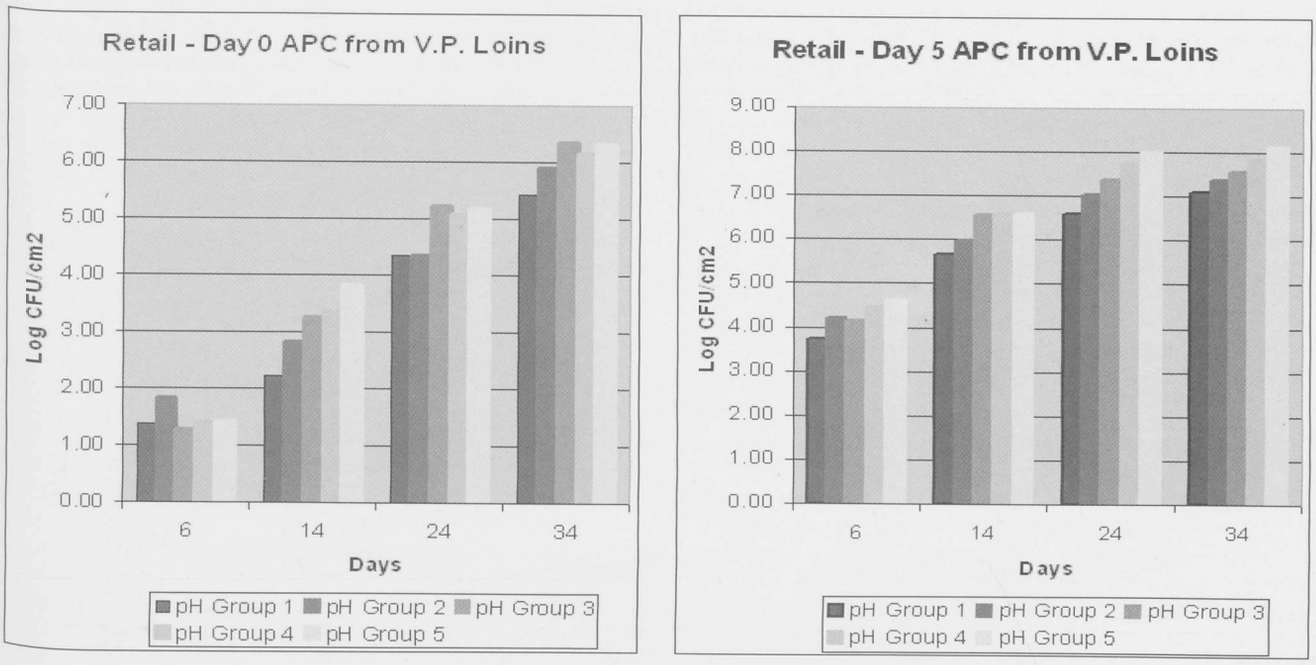

Figure 3. Aerobic Plate Count for retail packaged pork loin slices by pH at Day 0 and 5 of storage at 5°C. Slices cut from vacuum-packaged pork loins stored up to 34 days at 4°C.

Figure 3 shows the results from the APC of retail packaged loin slices at day 0 (after vacuum storage) and day 5 after retail storage. The APC on the surface of the sliced pork loins ranged from 1.28 to 6.35 log CFU/cm^2 at day 0 of retail storage depending on the storage time of the vacuum-packaged samples from which they were cut. There was little practical difference (< ca. 1 log) among the groups except before day 14. The major difference came at day 14 where group 1 was lower than groups 3-5. APC of group 1 was significantly lower than of group 2-5.
After 5 days of retail storage, APC of pH groups 1 and 2 were significantly lower than groups 4 and 5 (Figure 3). For retail samples cut from 6-day-old vacuum-packaged loins, group 1 was significantly lower than group 5. Group 1 was consistently 1.0-1.5 logs lower than group 5 throughout the storage of the vacuum-packaged samples. None of the retail samples reached log 7.0 CFU/cm^2 until after 24 days vacuum-packaged storage and 5 d retail storage.
Our results are in agreement with Rey et al., (1976) who found that microorganisms grew most rapidly on dark pork with higher pHs and slowest on PSE pork with lower pHs. Rey et al. (1976) compared pale, soft, exudative (PSE), dark cutting, and normal colored pork were compared to determine differences in susceptibility to microbial growth. Chops were packaged and stored under simulated retail conditions.
The results of this study are based on a preliminary analysis of data from pork loins that were stored at challenging temperature conditions. The increase in APC will be slowed down by storage at 0°C compared to 4°C. Additional data on other microbiological and meat quality characteristics are being analyzed. In general these preliminary data demonstrate that higher pH (pH > 5.85) pork has a shorter microbiological shelf life than lower pH pork. Lower pH pork has higher drip loss and than higher pH pork.

Pertinent literature

Eikelenboom, G., Van der Wal, P.G., and De Vries, A.G. 1995. The significance of ultimate pH for pork quality. Proc. 41st ICoMST, August 20-25, 1995, USA. Vol II, pp. 654-655.
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Rey, C.R., A.A. Kraft, D.G Topel, F.C. Parrish, Jr., and Hotchkiss D.K. 1976. Microbiology of pale, dark and normal pork. J. Food Sci. 41:111-116.